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THEORETICAL AND EXPERIMENTAL STUDIES IN ASTROPHYSICS

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CONTENTS

1: Introduction

This report summarises research activities in Laboratory Astrophysics, carried out in the Physics Department, University of Western Ontario, between August 1 1965 and January 31 1966.

Building renovations described in the last report have continued, and the re-construction in the laboratories now occupied under this programme was completed by the middle of January 1966. Needless to say this has been a serious disruption, and since most of the equipment was dismantled and stored last summer, very little experimental work has been possible since then.

2: Overall Research Programme

With Dr. Nicholls having left, and taken most of the equipment with him, the scope of the programme is considerably reduced. However, the laboratory is still adequately equipped to continue the following work.

Experimental

Intensity measurements on molecular spectra

Atlas of molecular spectra (in collaboration with Nicholls)

Ion beam spectroscopy

(Laser excitation of powdered solids - terminated during report period)

(Shock tube spectroscopy - terminated during report period)

Theoretical

Studies of molecular potential and wave functions

Studies of derived quantities of vibrational wave functions

Vibration-rotation studies

Atomic collisions

3: Personnel

The following personnel have contributed to the research programme

Faculty:

Dr. H.I.S. Ferguson, Associate Professor of Physics

Dr. P.A. Fraser, Professor of Physics

Mr. W.R. Jarmain, Assistant Professor of Physics

Dr. R.C. Murty, Assistant Professor of Physics

Graduate Students (Supported by scholarship as indicated)

Mr. V. Degen

Mr. G.W.F. Drake (NRC Scholarship)

Mr. J.P. Fallona (completing his work at York University)

Mr. M. Kraidy

Mr. R.P. Lowe (DRB on leave - now returned to DRB)

Mr. J.E. Mentall

Mr. A. McGregor (NRC Scholarship)

Mr. J.A. Myer (ORF Scholarship)

Graduate Technical Assistants

Mrs. M. Murty (terminated October 31 1965)

Mrs. S. Innanen

4: Experimental Studies

4.1 Intensity Measurements on Molecular Spectra

Mr. Degen has completed intensity measurements on the O_2 Herzberg system, which is an important contributor to the spectrum of the airglow, and is well along with his Ph.D. thesis.

Mr. Drake has completed an experimental and theoretical study of the intensity distribution in the BeO Blue-Green System, and his completed thesis is about to be submitted.

Mr. Fallona continues to work on a number of CO band systems.

4.2 Shock tube Spectroscopy

Mr. Myer has completed his studies of shock wave - powder particle interactions, and completed the requirements for the M.Sc. degree in December 1965.

Mr. McGregor has completed oscillator strength measurements of shock excited MgH bands, and his Ph.D. thesis is approaching completion.

4.3 Ion Beam Spectroscopy

Mr. Lowe has completed his spectroscopic studies of 2-10 KeV alkali ion beams into a variety of gases, and is on the point of submitting his Ph.D. thesis.

Dr. Ferguson is continuing the above work, as well as being engaged in the further development of a proton accelerator, but for reasons stated in the introduction, no experimental work has been done in this field during the report period.

The proton accelerator was dismantled even prior to the last report period (i.e. before August 1 1965). Considerable reconstruction is necessary - in particular a new H.V. power supply has been ordered, the vacuum system needs rebuilding, and the magnetic analysis system is to be incorporated. Design work is progressing.

4.4 Laser Excitation of Powdered Solids

Mr. Mentall has completed his quantitative spectroscopic studies, and completed all requirements for the Ph.D. degree in January 1966.

5: Theoretical Studies

5.1 Atomic Collisions

Mr. Kraidy and Dr. Fraser are extending iterative methods of solution of equations of atomic collision theory. They are also studying positron-helium collisions.

Dr. Fraser is studying positronium-helium collisions, and the "pick-off" quenching rate of positronium in helium.

5.2 Franck-Condon Factors

A successful study of methods of interpolation between arrays of Franck-Condon factors, completed by Dr. Nicholls during previous report period, has been published.(3)

Mr. Jarmain has continued his computations of Franck-Condon factors and densities appropriate to realistic potentials for the $v'' = 0$, 1 and 2 progressions and photo-dissociation continuum of the Herzberg system of O_2. This work is in preparation for publication.

6: Publications

6.1 Published Papers (appeared during report period)

(1) **Interpolation of Franck-Condon Factor Arrays for Molecular Band Systems**
Journal of Quantitative Spectroscopy and Radiative Transfer, 5, 647, 1965
R.W. Nicholls

(2) The Application of an Iteration-Variation Method to Atomic Scattering Problems
Proceedings of the Physical Society 86, 477, 1965.
R.P. McEachran, P.A. Fraser, J.B.G. Wallace and C.E. Tull

(3) Absolute Band Strengths for the C_2 Swan System
Proceedings of the Physical Society 86, 873, 1965.
J.E. Mentall and R.W. Nicholls

6.2 Theses

(4) Laser Excitation of Powdered Solids
Ph.D. thesis, 1966, University of Western Ontario
J.E. Mentall

(5) Ablation in a Shock Tube
M.Sc. thesis, 1966, University of Western Ontario
J.A. Myer

6.3 Publications in Press

(6) The Bound-Free Absorption Coefficient of the Negative Hydrogen Ion
Monthly Notices of the Royal Astronomical Society
N.A. Doughty, P.A. Fraser and R.P. McEachran

(7) The Free-Free Absorption Coefficient of the Negative Hydrogen Ion
Monthly Notices of the Royal Astronomical Society
N.A. Doughty and P.A. Fraser

6.4 Orally presented Papers

Nil